

The ecology of invasive species: Parallels with endangered species, unique features, and economic implications

Dr. Mark C. Andersen
Department of Fishery and Wildlife Sciences
New Mexico State University
Las Cruces, NM

Acknowledgements

- Richard Fite, USDA/APHIS
- Mark Powell, USDA/ORACBA
- Brian Hurd, NMSU
- Carol Stepien & Tarun Mal, Cleveland State University
- Heather Adams, Stephanie Caballero, Sarah Salameh, Nicole Tatman, Jason Northcott, Megan Ewald

Aims of this presentation

- What are some ecological issues relevant to invasive species, and what similarities exist with endangered species issues?
- What are some unique ecological features of species invasions ?
- How can ecological data and concepts mesh with economic analyses of species invasions?

What are some ecological issues relevant to invasive species, and what similarities exist with endangered species issues?

Theoretical ecology and invasive species: The need for synthesis

- Disagreements over interpretation of data
- Limitations on quantity and quality of available data
- Need for decisions based on limited information, with uncertain consequences and unknown reversibility
- Simulations appealing as proxies for non-feasible experiments

Main concerns of theoretical ecology *re* invasions

- Which species will invade (entry)
- Susceptibility of habitats (establishment)
- Rate of increase of invader's geographic range (spread)
- Effects of invader on native species/ecosystems (impact)

Invasive species and conservation biology

- Theoretical questions the inverse of some classic questions of conservation biology
- Especially true for questions relating to extinction
- Need for stochastic models

Invasive species: Ecological parallels with endangered species

- Importance of stochasticity
- Importance of small-population phenomena (establishment the flip side of extinction?)
- Importance of spatial factors (landscape structure, dispersal) in population persistence
- Potential role of theoretical ecology in providing general rules of thumb for guidance

What are some unique
ecological features of
species invasions ?

Importance of spatial spread

- In addition to the landscape and habitat factors that are crucial for endangered species, dispersal processes are important considerations for invasives
- Empirical concepts: lag phase, jump dispersal, colony coalescence
- Theoretical concepts: diffusion models, integrodifference models (dispersal kernel)

Role of species interactions

- Competitive interactions
 - Facilitation of one invasive by another
 - Invasive predators
 - Invasive pathogens
-
- Common thread: Nature of the ecological interaction dictates unique features of the dynamics of that interaction

Distinct small-population phenomena

- Demographic stochasticity
Stochastic effects due to discrete-process nature of births and deaths, distinct from environmental stochasticity
- Allee effect
Positive density-dependence at low population densities, often due to mate-finding difficulty at low density; can be overcome by facultative parthenogenesis

How can ecological data
and concepts mesh with
economic analyses of
species invasions?

Economic impacts of invasive species

- Direct costs in lives (diseases), crop losses (direct-use value)
- Costs of interdiction and control programs (direct-use value)
- Costs in terms of reduced ecosystem function/services (indirect-use value)
- Costs in terms of biodiversity loss (existence value? opportunity costs?)
- Estimation and valuation get harder as you go down the list, but long-term effects may be more important

Relevant economic insights

- Recognition of sources of problems with invasive species (externality)
- Understanding damage to public goods
- Coping with uncertainty concerning risks and reversibility
- Costs and benefits of measures applied at different stages (entry, establishment, spread, impact)

Policy decisions

- Need to be based on marginal rather than total costs, integrating economic and ecological perspectives, data, and concepts
- Important decision problems relating to interdiction vs. control, choice of control strategies

A comprehensive invasive species strategy

- Must address all phases (entry, establishment, spread, and impact)
- Must integrate ecological and economic approaches in analyses of risks, costs, and benefits